REDUCING FALSE POSITIVE DETECTIONS OF MALIGNANT LESIONS USING MULTI-PARAMETRIC MAGNETIC RESONANCE IMAGING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/912,709, filed Oct. 9, 2019, the disclosure of which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates generally to reducing false positive detections of malignant lesions, and more particularly to reducing false positive detections of malignant lesions for prostate cancer detection using multi-parametric magnetic resonance imaging.

BACKGROUND

[0003] Prostate cancer is one of the most prevalent forms of cancer. Diagnosis of prostate cancer traditionally involves screening patients experiencing prostate cancer symptoms by administering a prostate specific antigen (PSA) blood test and, for patients with an elevated PSA, performing a biopsy to confirm the prostate cancer diagnosis. However, the PSA blood test has a high rate of over diagnosis of prostate cancer, resulting in unnecessary and invasive intervention of the patient and increase in medical costs.

[0004] Recently, multi-parametric magnetic resonance imaging (mpMRI) has been proposed for the detection, localization, and classification of prostate cancer. Conventional techniques for computer-aided detection of prostate cancer using mpMRI images have been found to achieve comparable detection sensitivity as compared to a radiologist, however with a relatively lower specificity. Such lower specificity results in over diagnosis of prostate cancer, also resulting in unnecessary and invasive intervention of the patient and increase in medical costs.

BRIEF SUMMARY OF THE INVENTION

[0005] In accordance with one or more embodiments, systems and methods for reducing false positive detections of malignant lesions are provided. A candidate malignant lesion is detected in one or more medical images, such as, e.g., multi-parametric magnetic resonance images. One or more patches associated with the candidate malignant lesion are extracted from the one or more medical images. The candidate malignant lesion is classified as being a true positive detection of a malignant lesion or a false positive detection of the malignant lesion based on the one or more extracted patches using a trained machine learning network. The results of the classification are output.

[0006] In one embodiment, a plurality of patches having different fields of view are extracted from the one or more medical images. For example, the plurality of patches may be extracted by cropping the one or more medical images at different dimensions. In one embodiment, a patch depicting the candidate malignant lesion from a particular image of the one or more medical images and patches from images of the one or more medical images that neighbor the particular image are extracted as the one or more patches associated with the candidate malignant lesion.

[0007] These and other advantages of the invention will be apparent to those of ordinary skill in the art by reference to the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** shows a workflow for detecting and evaluating malignant lesions, in accordance with one or more embodiments;

[0009] FIG. **2** shows a method for reducing false positive detections of malignant lesions, in accordance with one or more embodiments;

[0010] FIG. **3** shows a network architecture of a machine learning based false positive detection network for classifying candidate malignant lesions as being true positive detections of a malignant lesion or false positive detections of the malignant lesion, in accordance with one or more embodiments;

[0011] FIG. **4** shows a framework of a pyramidal feature hierarchical approach for training a false positive detection network for classifying candidate malignant lesions as being true positive detections of a malignant lesion or false positive detections of the malignant lesion, in accordance with one or more embodiments;

[0012] FIG. **5** shows a table comparing various embodiments described herein; and

[0013] FIG. **6** shows a high-level block diagram of a computer.

DETAILED DESCRIPTION

[0014] The present invention generally relates to systems and methods for reducing false positive detections for malignant lesions using multi-parametric magnetic resonance imaging (mpMRI). Embodiments of the present invention are described herein to give a visual understanding of such systems and methods. A digital image is often composed of digital representations of one or more objects (or shapes). The digital representation of an object is often described herein in terms of identifying and manipulating the objects. Such manipulations are virtual manipulations accomplished in the memory or other circuitry/hardware of a computer system. Accordingly, is to be understood that embodiments of the present invention may be performed within one or more computer systems using data stored within the computer systems.

[0015] While the embodiments described herein are described for reducing false positive detections of malignant lesions for prostate cancer, the present invention is not so limited. The embodiments described herein may be applied for reducing false positive detections of malignant lesions for any type of cancer or for reducing false positive classifications of any type of abnormality (e.g. nodules) in a medical image.

[0016] FIG. **1** shows a workflow **100** for detecting and evaluating malignant lesions, in accordance with one or more embodiments. Workflow **100** comprises two stages: a candidate malignant lesion detection stage **120** and a false positive reduction stage **122**. In candidate malignant lesion detection stage **120**, the goal is to detect malignant lesions with a high degree of sensitivity. In false positive reduction stage **122**, the goal is to minimize the false positive detection rate of the detected malignant lesions with minimal impact to the sensitivity.